THIN FILM SOLAR CELL GROWTH ON THE SURFACE OF THE MOON BY VACUUM EVAPORATION. A. Ignatiev, A. Freundlich, and T. Kubricht, Space Vacuum Epitaxy Center, University of Houston, Houston TX 77204-5507, USA.

The need for significant electrical power on the surface of the Moon, and the unique ultra-high vacuum environment of the Moon can allow for the direct fabrication of solar cells on the lunar surface by vacuum evaporation. The availability of significant electric power at the surface of the Moon will be principal driver defining the complexity of a future lunar base. Proposals to generate power on the Moon include both nuclear and solar (photovoltaic) systems. The main drawback to all of the approaches to date is that all of the mass for the power system must be transported from the Earth to the Moon. For the lunar base this could amount to over 40 metric tons to the Moon for the utilization phase.

A more efficient and synergistic approach is to attempt to utilize existing lunar resources to generate the electric power system. The synergism occurs from the fact that there is an ultra-high vacuum environment on the surface of the Moon, and that there are materials present on the Moon from which thin film solar cells could be made within this vacuum environment. The vacuum environment is directly applicable to the vacuum deposition growth of thin film solar cells, and there have already been lunar regolith processing techniques proposed that would have as by-products elemental materials that could be specifically used to generate thin film solar cells. As a result, thin film solar cell production on the lunar surface with *in situ* resource utilization is a viable approach for electric power generation on the Moon.

Lunar resource utilization has focused principally on the extraction of oxygen from the lunar regolith. These processes have as their by-products (or more directly as their “waste products”) materials such as iron, silicon, and magnesium, and these materials are the ones specifically needed for the fabrication of silicon solar cells. Pressures on the surface of the Moon are generally in the 1×10^{-10} Torr range or better, thus representing a near-ideal environment for direct vacuum deposition of thin film silicon solar cells using the “waste” silicon present on the Moon.

The quality of the “waste” materials may be poor as the impurity levels will probably be beyond those acceptable for “solar cell-grade” materials. As a result, a reduction of efficiency is to be expected unless additional prufication is undertaken. However, since an aim of the lunar initiative is to use *in situ* lunar resources, a decrease of efficiency can be tolerated and compensated for by simply growing more net cell area.

The proof-of-concept direct lunar vacuum evaporation of solar cells promises to be a major impact to lunar utilization. Not only will major amounts of mass-to-orbit be reduced by this technique, but it will also clearly demonstrate full utilization of lunar resources for power generation. The extent of this process and application of this philosophy to future planetary explorations is unlimited.